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Important calcareous foraminifera of the type-locality of the genus *Quadratobuliminella* DE KLASZ, region of Eisenärzt, Upper Bavaria

By

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With 2 Text-figures and 2 Plates

KURZFASSUNG

Die Foraminiferengattung *Quadratobuliminella*, erstmals beschrieben von der Typlokalität Grub nördlich von Eisenärzt (Oberbayern) und der Lokalität Bidart, SW Frankreich, (DE KLASZ 1953 a), wurde seitdem in zahlreichen Sedimenten sowohl des Nord- und Südatlantiks als auch des Pazifiks gefunden und gilt als kosmopolitische Tiefwasser-Leitform hauptsächlich des Paläogens (VAN MORKHOVEN et al. 1986). Die vorliegende Arbeit stellt die Topotypen der Gattung sowie die wichtigsten Kalkschaler aus der inzwischen überbauten Typlokalität in Rasterelektronenmikroskop-Aufnahmen vor und gibt weitere Angaben zur geographischen und stratigraphischen Verbreitung von *Quadratobuliminella*. Aufgrund der planktonischen Foraminiferen konnte das stratigraphische Alter des Typ-Stratums als höheres Dan, unterer Teil: untere P2-Zone sensu BLOW präzisiert werden (vgl. DE KLASZ et al. 1990).

ABSTRACT

The foraminiferal genus *Quadratobuliminella* DE KLASZ, 1953 is a cosmopolitan essentially Early Paleogene deep water index fossil. This study presents SEM photographs of the type species of *Quadratobuliminella* and numerous important calcareous foraminifera of the type locality which is no longer accessible due to road construction. According to the planktonic foraminifera the age of the type locality can be specified as Upper Danian, lower part of zone P2 sensu BLOW (cf. DE KLASZ et al. 1990). Both agglutinated forms (DE KLASZ & DE KLASZ 1990) and the most important calcareous species (planktonic and benthic) here figured show strong similarities to approximately coeval bathyal assemblages from various parts of the globe.

1. INTRODUCTION

As mentioned in two earlier papers (DE KLASZ et al. 1990, DE KLASZ & DE KLASZ 1990), our re-examination of the two existing samples from the *Quadratobuliminella* type locality (fig. 1 a and b) was mainly prompted by the fact that the genus proved itself to be a worldwide mainly Paleogene index form (VAN MORKHOVEN et al. 1986). For this reason, and because of the inaccessibility of the type locality as a consequence of road construction, an illustration of the microfauna of the only existing samples of this locality appears justified. In DE KLASZ et al.'s 1990 paper the planktonic foraminifera were not illustrated and in DE KLASZ & DE KLASZ's 1990 paper only the agglutinated forms could be discussed in detail.

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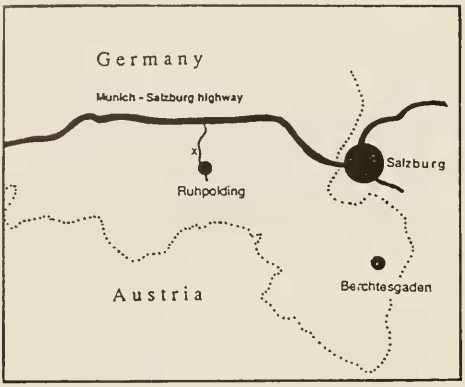


Fig. 1 a

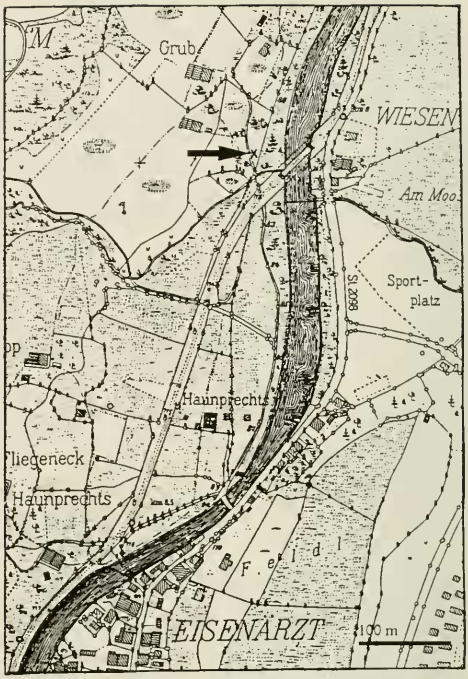


Fig. 1 b

Fig. 1 a and 1 b: Regional and precise localisation of the *Quadratobuliminella* type locality (x). (Reproduction of part of Land-map (Flurkarte) 1:5000, sheet SO 16-35 with permission of the Bayerisches Landesvermessungsamt, n° 7705/89).

Hereunder we mention and illustrate the most important calcareous species, including the planktonic ones, topotypes of *Quadratobuliminella pyramidalis* and forms also encountered for instance by VON HILLEBRANDT (1962) in the Paleocene of the Bad Reichenhall and Salzburg basins and by diverse authors in various regions of the South Atlantic. For reason of space, apart from of the original description, only a few references from these areas are given for each species. A more detailed bibliography is included for instance in DE KLASZ et al. (1988).

The figured specimens are deposited in the Bayerische Staatssammlung für Paläontologie und historische Geologie, Munich, Germany.

The preparation of this paper was encouraged by Prof. Dr. K. F. WEIDICH, who also kindly arranged the SEM photography of our specimens before his untimely death. We are indebted to the Institute of Paleontology and historical Geology of the University of Munich for enabling our work to be carried out, and to Mrs. R. LIEBREICH who took the SEM pictures and kept in contact with us during Professor WEIDICH's illness. Prof. G. NICAISE Director of the Laboratory for Applied Microscopy the University of Nice kindly made it possible for us to use the laboratory's darkroom to make prints of the negatives. Miss Sophie PAGNOTTA and Mr. Jean Pierre LAUGIER of the laboratory staff seconded us in every possible way. D. SCHNITKER of Walpole, Me., USA, and J. WIDMARK of Uppsala kindly sent us material of comparison. We are most grateful to Dr. W. WERNER of the Bayerische Staatssammlung für Paläontologie und historische Geologie as well as to Mrs. M. DALLOS for revising the text.

2. THE *QUADRATOBULIMINELLA* TYPE LOCALITY

2.1 REMARKS CONCERNING THE *QUADRATOBULIMINELLA* TYPE LOCALITY

The structural position of the type stratum has been discussed among others by DE KLASZ & DE KLASZ (1990). They considered it, as did DE KLASZ (1953 b), as a tectonic and not stratigraphic intercalation in the Bucheck Schichten. The recent finding of a sample residue collected by one of us (I. K.) in 1953 about 20 m S of the *Quadratobuliminella* type locality (containing a rich Campanian fauna, with numerous Globotruncanids of „Bucheck type") confirms this statement decisively: it proves that Senonian Bucheck Layers exist both North and South of the *Quadratobuliminella* bearing levels. The section figured by DE KLASZ & DE KLASZ (1990) has been modified accordingly (Fig. 2).

2.2 FAUNAL AFFINITIES OF THE CALCAREOUS FAUNA FROM THE GRUB LOCALITY

A considerable part of the calcareous foraminifers of the Grub material was also encountered by VON HILLEBRANDT (1962) in the Bad Reichenhall and Salzburg basins, which are only 30 to 40 km away, as well as by various authors in numerous South Atlantic localities and the Carribean region. The planktonic foraminifers indicate Upper Danian age. Because of the coexistence of *Morozovella trinidadensis* and *M. uncinata*, DE KLASZ et al. (1990) attributed them to the lower part of BLOW's P2 zone. The bathymetric interpretation of the Grub material and the relationship of the latter with geological features of the area is shortly given in DE KLASZ & DE KLASZ (1990) where further references concerning these are also in-

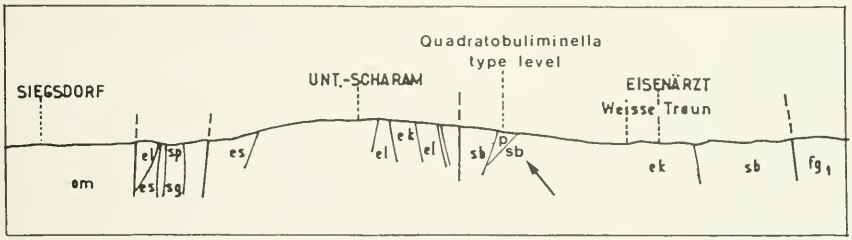


Fig. 2: Geological section 1:25 000 between the sedimentologic-tectonic units from Flysch (fg_1) to molasse (om) in the region of Eisenärzt and Siegsdorf indicating the tectonic position of the Danian level of Grub (p) (after GANSS 1956, modified). Arrow points to Bucheck locality encountrered to the south of the *Quadratobuliminella* type locality (p). For abbreviations see also DE KLASZ & DE KLASZ, 1990: fig. 4.

cluded. The composition of the calcareous assemblage confirms the data obtained from agglutinating forms. Although many species are also found in the Danian fauna of Senegal (DE KLASZ et al. 1988 (P1 zone)), their relative abundance is rather different. It recalls rather the associations considered by NYONG & OLSSON (1986) as being characteristic of mesobathyal conditions.

HAGN et al. (1981) mention that no hiatus can be observed between the Late Cretaceous and Early Paleogene in the Ultrahelvetic zone in South-Eastern Bavaria. In the Grub locality the presence of some Globotruncanids in the Danian fauna shows however that some reworking occurred.

2.3 TAXONOMIC REFERENCES AND REMARKS

2.3.1 Planktonic foraminifera

Chiloguembelina subtriangularis BECKMANN, 1957
Pl. 1, Fig. 1

1957 *Chiloguembelina subtriangularis* n. sp. - BECKMANN: 91, pl. 21/5, text-fig. 15/39-42.

Globigerina triloculinoides PLUMMER, 1926
Pl. 1, Fig. 2 a-c

1926 *Globigerina triloculinoides* n. sp. - PLUMMER: 134, pl. 8/10.

1975 *Globigerina triloculinoides* PLUMMER. - STAINFORTH et al.: 234, fig. 92.

1985 *Globigerina triloculinoides* PLUMMER. - TOUMARKINE & LUTERBACHER: 117, fig. 19/1 a-2 c.

Morozovella inconstans (SUBBOTINA, 1953)
Pl. 1, Fig. 3 a-c

1953 *Globigerina inconstans* n. sp. - SUBBOTINA: 58, pl. 3/1-2.

1975 *Globorotalia inconstans* (SUBBOTINA). - STAINFORTH et al.: 193, fig. 55.

1985 *Morozovella inconstans* (SUBBOTINA). - TOUMARKINE & LUTERBACHER: 110, fig. 13/1 a-2 c.

Morozovella praecursoria (MOROZOVA, 1957)
Pl. 1, Fig. 6

1957 *Acarinina praecursoria* n. sp. - MOROZOVA: 1111, fig. 1.

1975 *Globorotalia praecursoria* (MOROZOVA). - STAINFORTH et al.: 214-215, fig. 74.

1985 *Morozovella praecursoria* (MOROZOVA). - TOUMARKINE & LUTERBACHER: 110, fig. 13/5 a-c.

Morozovella pseudobulloides (PLUMMER, 1926)
Pl. 1, Fig. 4 a-b

1926 *Globigerina pseudobulloides* n. sp. - PLUMMER: 33, pl. 8/9.

1975 *Globorotalia pseudobulloides* (PLUMMER). - STAINFORTH et al.: 216-217, fig. 76.

1985 *Morozovella pseudobulloides* (PLUMMER). - TOUMARKINE & LUTERBACHER: 110, fig. 14/1 a-2 c.

Morozovella trinidadensis (BOLLI, 1957)
Pl. 1, Fig. 5 a-c

1957 *Globorotalia trinidadensis* n. sp. - BOLLI: 73, pl. 16/19-23.

1975 *Globorotalia trinidadensis* BOLLI. - STAINFORTH et al.: p. 235, 237, fig. 93.

1985 *Morozovella trinidadensis* (BOLLI). - TOUMARKINE & LUTERBACHER: 110, fig. 13/3 a-4 c.

Morozovella uncinata (BOLLI, 1957)
Pl. 1, Fig. 7 a-c

1957 *Globorotalia uncinata* n. sp. - BOLLI: 74, pl. 17/13-15.

1975 *Globorotalia uncinata* BOLLI. - STAINFORTH et al.: 239, fig. 95.

1985 *Morozovella uncinata* (BOLLI). - TOUMARKINE & LUTERBACHER: 110, fig. 14/3 a-4 c.

Planorotalites compressa (PLUMMER, 1926)
Pl. 1, Fig. 8 a, b

1926 *Globigerina compressa* n. sp. - PLUMMER: 135, pl. 8/11.

1975 *Globorotalia compressa* (PLUMMER). - STAINFORTH et al.: 178, fig. 43.

1985 *Planorotalites compressa* (PLUMMER). - TOUMARKINE & LUTERBACHER: 107, fig. 12/1 a-2 c.

2.3.2 Benthic foraminifera

Anomalinoides acutus (PLUMMER, 1926)
Pl. 2, fig. 11 a-c

1926 *Anomalina ammonoides* (REUSS) var. *acuta* n. var. - PLUMMER: 149, pl.X/2 a-c.

1976 *Anomalinoides acuta* (PLUMMER). - SALAJ et al.: 161, IX/3 a-c, 6 a-b.

1983 *Cibicidoides dayi* (WHITE). - TJALSMA & LOHMANN: 9, pl. 6/6-7.

1988 *Anomalinoides acutus* (PLUMMER). - DE KLASZ et al.: 66, pl. 17/3 a-c.

Aragonia aff. *velascoensis* (CUSHMAN, 1925)
Pl. 1, Fig. 12 a, b

? 1925 *Textularia velascoensis* n. sp. - CUSHMAN: 18, pl. 3/1.

? 1988 *Aragonia* aff. *velascoensis* (CUSHMAN). - DE KLASZ et al.: 63, pl. 14/12 a-c.

Because of substantial recrystallisation and strongly adhering matrix an exact determination at the species level is not possible with certainty.

Bolivinoides delicatulus CUSHMAN, 1927
Pl. 1, Fig. 10 a-c

1927 *Bolivinoides decorata* (JONES) var. *delicatula*. - CUSHMAN: 90, pl. 4/8.

1983 *Bolivinoides delicatulus* CUSHMAN. - TJALSMA & LOHMANN: 5, pl. 4/7.

1986 *Bolivinoides delicatulus* CUSHMAN. - VAN MORKHOVEN et al.: 337-339, pl. 110/2 a-b.

1988 *Bolivinoides delicatulus* CUSHMAN. - DE KLASZ et al.: 57, pl. 12/9 a-c.

The taxonomy of this species has been discussed in detail by VAN MORKHOVEN et al. (1986).

Bolivinoides cf. *paleocenicus* (BROTZEN, 1948)
Pl. 1, Fig. 11 a, b

cf. 1948 *Bolivina paleocenica* n. sp. - BROTZEN: 66, pl.9/5.

? 1962 *Bolivinoides delicatulus* CUSHMAN. - VON HILLEBRANDT: 71, pl. V/13 (non 14).

cf. 1970 *Bolivinoides paleocenicus* (BROTZEN). - BARR: 650, pl. 99/7 a-b.

Our specimens are narrower than the specimens of *B. paleocenicus* (BROTZEN) figured by BROTZEN and by BARR. The sutures show generally a crenulation and most specimens exhibit some elevated lobes on the central part of the test.

Bulimina cf. *cooperensis* CUSHMAN, 1933
Pl. 1, Fig. 15 a, b

cf. 1933 *Bulimina cooperensis* n. sp. - CUSHMAN: 12, pl. 1/32 a-b.

cf. 1947 *Bulimina cooperensis* CUSHMAN. - CUSHMAN & PARKER: 98, pl. 22/19.

cf. 1992 *Bulimina trinitatensis* CUSHMAN & JARVIS. - WIDMARK & MALMGREN: pl. 1/7.

Our specimens are less slender than the Eocene species *B. cooperensis* CUSHMAN and the lamellar ornamentation usually reaches the top part of the chambers, even on the terminal part of the test. It differs from *Bulimina trinitatensis* in not having a lamellar (and sometimes perforated) lower edge of the chambers as described by the authors in the latter. (See also the SEM photograph fig. 16 on pl. 2 in PROTO-DECIMA & BOLLI (1978) which is very close to the original drawing of *B. trinitatensis*). On the other hand WIDMARK & MALMGREN's picture of *B. trinitatensis* is very similar to our form.

Plate 1

Fig. 1 *Chiloguembelina subtriangularis* BECKMANN. - Lateral view; S: 3.

Fig. 2 *Globigerina triloculinoides* PLUMMER. - a) Spiral side, S: 2; b) Profile, S: 3; c) Umbilical side, S: 3.

Fig. 3 *Morozovella inconstans* (SUBBOTINA). - a) Spiral side; b) Profile; c) Umbilical side; S: 2.

Fig. 4 *Morozovella pseudobulloides* (PLUMMER). - a) Spiral side; b) Profile; S: 2.

Fig. 5 *Morozovella trinidadensis* (BOLLI). - a) Spiral side, S: 2; b) Profile, S: 2; c) Umbilical side, S: 3.

Fig. 6 *Morozovella praecursoria* (MOROZOVA). - Umbilical side; S: 2.

Fig. 7 *Morozovella uncinata* (BOLLI). - a) Spiral side; b) Profile; c) Umbilical side; S: 2.

Fig. 8 *Planorotalites compressa* (PLUMMER). - a) Spiral side; b) Profile; S: 3.

Fig. 9 *Frondicularia jarvisi* CUSHMAN. - Lateral view, S: 2.

Fig. 10 *Bolivinoides delicatulus* CUSHMAN. - a) Lateral view; b) Profile; c) Opposite side; S: 3.

Fig. 11 *Bolivinoides* cf. *paleocenicus* (BROTZEN). - a) Lateral view; b) Opposite side; S: 2.

Fig. 12 *Aragonia* aff. *velascoensis* (CUSHMAN). - a) Lateral view, S: 4; b) Profile, S: 3.

Fig. 13 *Pyramidina* cf. *rudita* (CUSHMAN & PARKER). - Apertural side; S: 4.

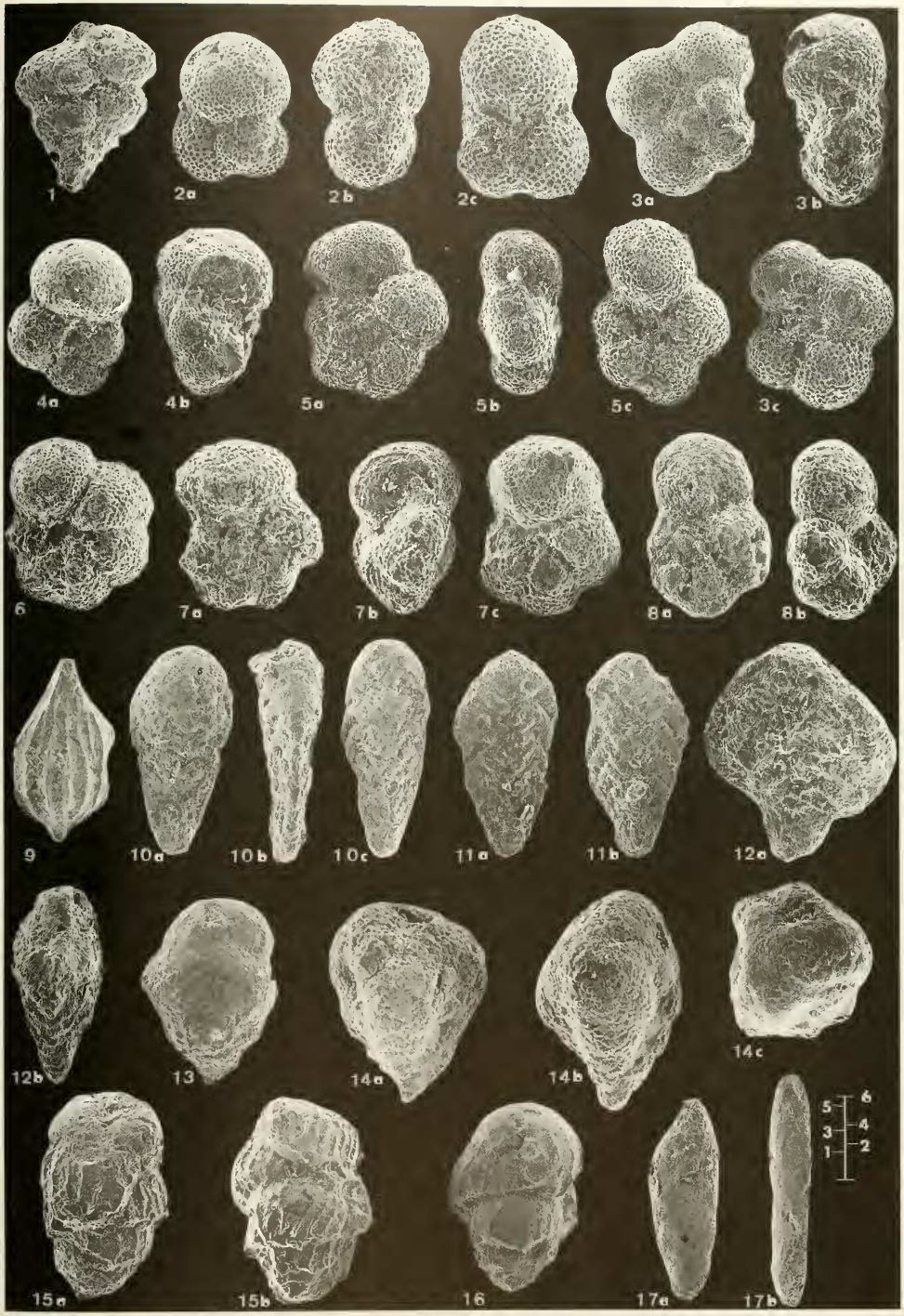
Fig. 14 *Pyramidina* aff. *triangularis* (CUSHMAN & PARKER). - a) Apertural side, S: 6; b) Opposite side, S: 6; c) Apertural view, S: 5.

Fig. 15 *Bulimina* cf. *cooperensis* CUSHMAN. - a) Apertural side; b) Opposite side; S: 3.

Fig. 16 *Bulimina taylorensis* CUSHMAN & PARKER. - Apertural side, S: 2.

Fig. 17 *Coryphostoma* cf. *midwayense* (CUSHMAN). - a) Lateral view, S: 2; b) Profile, S: 1.

Remark on enlargements: The enlargements indicated on the bar-scale correspond to 100 µ. The enlargements being different for the various figures, the figure/bar correlation is mentioned in the plate legend: S (scale) followed by a number. The scale number on the legend indicates 0.1 mm up to this number of the bar-scale.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8b
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10b
10c
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11b
12a
12b
13
14a
14b
14c
15a
15b
16
17a
17b
5
6
3
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1
2

Bulimina taylorensis Cushman & Parker, 1935
Pl. 1, Fig. 16

1935 *Bulimina taylorensis* n. sp. - Cushman & Parker: 96, pl. 15/3 a-b.

1962 *Bulimina trinitatensis* Cushman & Jarvis. - von Hillebrandt: 78-79, pl. V/27 a-b.

1982 *Bulimina trinitatensis* Cushman & Jarvis. - Boltovskoy & Watanabe: pl. 2/21.

1986 *Bulimina trinitatensis* Cushman & Jarvis. - van Morkhoven et al., partim: 300-303, 98B/2; non 98A/1 a-2 c, non 98B/1, 3, 4.

1988 *Bulimina taylorensis* Cushman & Parker. - de Klasz et al.: 60, pl. 13/5 a-c.

In a study on the Danian of Senegal, de Klasz et al. (1988) discussed the differences between *Bulimina taylorensis* and *Bulimina trinitatensis*. Van Morkhoven et al. (1986) interpreted the morphological differences in their figures of *B. trinitatensis* as being due to evolutionary change.

Coryphostoma aff. *midwayense* (Cushman, 1936)
Pl. 1, Fig. 17 a, b

1936 *Bolivina midwayensis* n. sp. - Cushman: 50, pl. 7/12 a-b, (fide van Morkhoven et al. 1986).

1978 *Coryphostoma* cf. *limonense* (Cushman). - Proto-Decima & Bolli: 792, pl. 2/1.

1983 *Coryphostoma* cf. *midwayensis* (Cushman). - Tjalsma & Lohmann: 12, pl. 2/7-8.

1985 *Bolivina midwayensis* (Cushman). - Brun et al.: 25, pl. III/7 a-f.

1988 *Bolivina midwayensis* Cushman. - de Klasz et al.: 57, pl. 12/8 a-b.

In the literature, several foraminifera identified and figured as *Bolivina limonensis* and *Coryphostoma limonense* respectively (see references above) correspond well with the original figure of *C. midwayense*.

?*Frondicularia jarvisi* Cushman, 1939
Pl. 1, Fig. 9

1939 *Frondicularia jarvisi* n. sp. - Cushman: 91, pl. 16/6.

1962 *Frondicularia jarvisi* Cushman. - von Hillebrandt: 62, pl. IV/14.

1988 *Frondicularia jarvisi* Cushman. - de Klasz et al.: 46, pl. 8 /12 a-b.

In our opinion, the figured specimen is the initial, even more juvenile stage of *Frondicularia jarvisi* Cushman, than the specimen illustrated in de Klasz et al. (1988), pl. 8, fig. 12 b.

Gavelinella velascoensis (Cushman, 1925)
Pl. 2, Fig. 14 a-c

1925 *Anomalina velascoensis* n. sp. - Cushman: 21, pl. 3/3 a-c.

1983 *Gavelinella velascoensis* (Cushman). - Tjalsma & Lohmann: 14, pl. 5/8 a-b.

1988 *Gavelinella rubiginosa* (Cushman). - de Klasz et al.: 66, pl. 17/2 a-c.

1992 *Gavelinella velascoensis* (Cushman). - Widmark & Malmgren: pl. 5/5 a-c.

non 1989 *Gavelinella velascoensis* (Cushman). - Boltovskoy & Boltovskoy: 305, pl. III/13-14.

Gavelinella aff. sp. A de Klasz, de Klasz & Ausseil-Badie, 1988
Pl. 2, Fig. 15 a-c

non 1928 *Rotalia beccariiformis* n. sp. - White: 187, pl. 39/2 a-c.

1982 *Gavelinella beccariiformis* (White). - Boltovskoy & Watanabe: 31, pl. 3/60-61.

1988 *Gavelinella* sp. A. - de Klasz, de Klasz & Ausseil-Badie: 67, pl. 17 a-c.

Plate 2

Fig. 1 *Quadratobuliminella pyramidalis* de Klasz. - a) Apertural side, S: 5; b) Apertural view, S: 6; c) Aperture, S: 7; d) Lateral view, S: 6; e) Apertural side, S: 5; f) Apical view, S: 6.

Fig. 2 *Nodosarella kugleri* Cushman & Renz. - Profile, S: 1.

Fig. 3 *Nodosarella subnodosa* (Guppy). - Profile, S: 1.

Fig. 4 *Pleurostomella paleocenica* Cushman. - Apertural side, S: 3.

Fig. 5 *Pleurostomella* sp. A de Klasz, de Klasz & Ausseil-Badie. - Side view, S: 5.

Fig. 6 *Stilostomella* sp. A de Klasz, de Klasz & Ausseil-Badie. - Side view, S: 2.

Fig. 7 *Nuttallinella* aff. *florealis* (White). - Profile, S: 2.

Fig. 8 *Pullenia coryelli* (White). - a) Lateral view; b) Profile; S: 3.

Fig. 9 *Pullenia* cf. *cretacea* Cushman. - a) Lateral view; b) Profile; S: 2.

Fig. 10 *Quadrimorphina trochoides* (Reuss). - a) Profile; b) Umbilical side; S: 4.

Fig. 11 *Anomalinoides acutus* (Plummer). a) Spiral side; b) Profile; c) Umbilical side; S: 1.

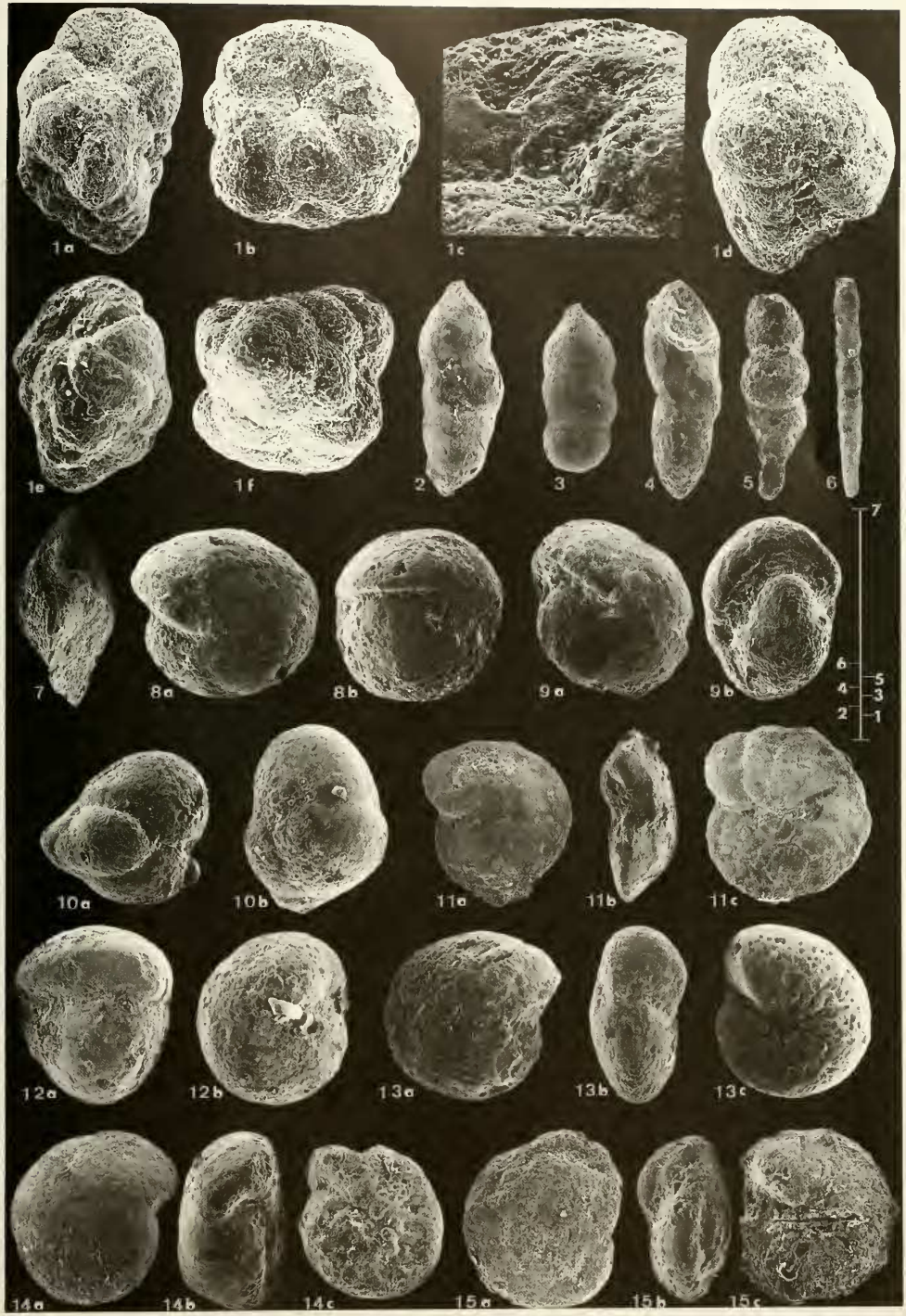
Fig. 12 *Gyroidinoides globosus* (von Hagenow). - a) Profile, S: 2; b) Umbilical side, S: 3.

Fig. 13 *Stensioeina beccariiformis* (White). - a) Spiral side, S: 4; b) Profile, S: 5; c) Umbilical side, S: 4.

Fig. 14 *Gavelinella velascoensis* Cushman. - a) Spiral side; b) Profile; c) Umbilical side; S: 2.

Fig. 15 *Gavelinella* aff. sp. A de Klasz, de Klasz & Ausseil-Badie. - a) Spiral side; b) Profile; c) Umbilical side; S: 2.

Remark on enlargements: The enlargements indicated on the bar-scale correspond to 100 µ. The enlargements being different for the various figures, the figure/bar correlation is mentioned in the plate legend: S (scale) followed by a number. The scale number on the legend indicates 0.1 mm up to this number of the bar-scale.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15a
15b
15c

The specimens of Grub are very similar to the species described in open nomenclature by DE KLASZ et al. (1988). For the Senegal form see remarks in the latter paper.

Gyroidinoides globosus (VON HAGENOW, 1842)
Pl. 2, Fig. 12 a, b

1842 *Nonionina globosa* n. sp. - VON HAGENOW: 574.
1962 *Gyroidinoides globosus* (VON HAGENOW). - VON HILLEBRANDT: 107, pl. IX/2 a-3 c.
1988 *Gyroidinoides globosus* (VON HAGENOW). - DE KLASZ et al.: 66, pl. 16/4 a-c.

Nodosarella kugleri CUSHMAN & RENZ, 1946
Pl. 2, Fig. 2

1946 *Nodosarella kugleri* n. sp. - CUSHMAN & RENZ: 42, pl. 6/30, 33.
1962 *Nodosarella kugleri* CUSHMAN & RENZ. - VON HILLEBRANDT: 96, pl. VIII/7, 17, 18 a-b.

Nodosarella subnodosa (GUPPY, 1894)
Pl. 2, Fig. 3

1894 *Ellipsoidina subnodosa* n. sp. - GUPPY: 640, pl. 41/12.
1962 *Nodosarella subnodosa* (GUPPY). - VON HILLEBRANDT: 97, pl. 7/14-16.
? 1978 *Nodosarella subnodosa* GUPPY. - PROTO-DECIMA & BOLLI: 795, pl. 3/18.

Nuttallinella aff. *florealis* (WHITE, 1928)
Pl. 2, Fig. 7

? 1928 *Gyroidina florealis* n. sp. - WHITE: 293, pl. 4/3 a-c.
1951 *Gyroidina florealis* WHITE. - NOTH: 70-71, pl. 7/8 a-c.
1962 *Osangularia florealis* (WHITE). - VON HILLEBRANDT: 109, pl. IX/13 a-14 c.
1978 *Charltonina florealis* (WHITE). - PROTO-DECIMA & BOLLI: 79, pl. 4/17-18.
1982 *Charltonina florealis* (WHITE). - BOLTOVSKOY & WATANABE: 31, pl. 2/31-32.
? 1986 *Nuttallinella florealis* (WHITE). - VAN MORKHOVEN et al.: 356-358, pl. 115/1-3.
1988 *Charltonina florealis* (WHITE). - DE KLASZ et al.: 65, pl. 16/2 a-c.
1992 *Nuttallinella florealis* (WHITE). - WIDMARK & MALMGREN: pl. 2/4 a-c.

Our form, like the ones observed in approximately coeval levels of Senegal are less high than the original drawing of WHITE or the specimen figured by VAN MORKHOVEN et al. (1986) from the Gulf of Mexico. We follow the example of various authors in calling this form „*Nuttallinella* (or *Osangularia*, or *Charltonina*) *florealis*", while admitting that this determination is questionable. During the drafting of our paper on the Danian of Senegal (DE KLASZ et al. 1988) we did not have VAN MORKHOVEN et al.'s book, which gives SEM pictures of a form obviously identical with the specimen drawn by WHITE; VAN MORKHOVEN et al. discuss in detail the taxonomy and stratigraphic distribution of *N. florealis*. In view of the taxonomic problems connected with the latter as shown by WHITE and VAN MORKHOVEN et al. and the forms figured under this name by various other authors, a study of a large number of this cosmopolitan index form in the type area would be most useful. Such a study would make it possible to find out whether the specimens observed by some authors in the Bavarian Alps and the Southern Atlantic fall within the variation spectrum of the species *N. florealis* or represent a new species or subspecies.

Pleurostomella paleocenica CUSHMAN, 1947
Pl. 2, Fig. 4

1947 *Pleurostomella paleocenica* n. sp. - CUSHMAN: 68, pl. 18/14-15.
1962 *Pleurostomella paleocenica* CUSHMAN. - VON HILLEBRANDT: 95, pl. VII/27.
1988 *Pleurostomella paleocenica* CUSHMAN. - DE KLASZ et al.: 61, pl. 13/8 a-b.

Pleurostomella sp. A DE KLASZ, DE KLASZ & AUSSEIL-BADIE 1988
Pl. 2, Fig. 5

1988 *Pleurostomella* sp. A. - DE KLASZ, DE KLASZ & AUSSEIL-BADIE: 61, pl. 14/2 a-b.

Pullenia coryelli WHITE, 1929
Pl. 2, Fig. 8 a, b

1929 *Pullenia coryelli* n. sp. - WHITE: 56, pl. 5/22 a-b.
1962 *Pullenia coryelli* WHITE. - VON HILLEBRANDT: 94, pl. 6/34 a-b.
1988 *Pullenia coryelli* WHITE. - DE KLASZ et al.: 64, pl. 15/4 a-b

This species has been figured in various publications on the Early and Middle Paleocene in Central and South America, as well as in the Southern Atlantic and in Europe. VAN MORKHOVEN et al. (1986) consider it as a characteristic element of „lower bathyal" (1000-1500 m) water depths.

Pullenia cf. *cretacea* CUSHMAN, 1936
Pl. 2, Fig. 9 a, b

cf. 1936 *Pullenia cretacea* n. sp. - CUSHMAN 1936 (a): 75, pl. 13/8 a-b.
1983 *Pullenia eocenica* CUSHMAN & SIEGFUS. - TJALSMA & LOHMANN: 36, pl. 16/1.
1988 *Pullenia cretacea* CUSHMAN. - DE KLASZ et al.: 64, pl. 15/5 a-b.

Some foraminifers identified and figured as *P. eocenica* by various authors (see for instance references above) are very similar to *P. cretacea*. Only the study of large populations from the type locality and from intermediate levels could show whether they are different species or varieties of the same taxon.

?Pyramidina cf. *rudita* (Cushman & Parker, 1936)
Pl. 1, Fig. 13

cf. 1936 *Bulimina rudita* n. sp. - Cushman & Parker: 45, (fide Cushman & Parker 1947).

cf. 1947 *Bulimina rudita* Cushman & Parker. - Cushman & Parker: 82-83, pl.19/26.

cf. 1983 *Pyramidina rudita* Cushman & Parker. - Tjalsma & Lohmann: 19, pl. 4/2, 7/2.

1988 *Pyramidina* cf. *rudita* Cushman & Parker. - de Klasz et al.: 60, pl. 13/4 a-b.

1992 *Pyramidina* cf. *rudita* Cushman & Parker. - Widmark & Malmgren: pl. 1/12.

Although subtriangular in section this form does not show the strong overlapping of the last few chambers, nor the apertural characteristics of *Pyramidina*, as described by Loeblich & Tappan (1988).

Pyramidina aff. *triangularis* Cushman & Parker, 1935
Pl. 1, Fig. 14 a-c

1935 *Bulimina triangularis* n. sp. - Cushman & Parker: 97, pl. 15/4 a-b.

1947 *Bulimina triangularis* Cushman & Parker. - Cushman & Parker: 82, pl. 19/25 a-b.

The strong recrystallisation of the Grub specimens do not allow a more precise determination.

Quadratobuliminella pyramidalis de Klasz, 1953
Pl. 2, Fig. 1 a-f

Type reference: I. de Klasz (1953): *Quadratobuliminella* n. gen., eine neue Foraminiferengattung von der Wende Kreide-Tertiär. - N. Jb. Geol. Paläont., Mh., 10: 434-436, fig. 1 (holotype), fig. 2 (paratype), (x 76).

Type specimen: holotype: Prot. 321; paratype: Prot. 322, deposited in the Bayerische Staatssammlung für Paläontologie und historische Geologie, Munich, Germany.

Type level: Dark greyish brown shales of Danian age (P2 zone) tectonically intercalated in Bucheck Beds „along a footpath W of the railway bridge of Wiesen", N Eisenärzt, south of the hamlet of Grub, 50 m N of the crossing of railway (Fig. 1 b).

Paratype: From the Danian of Bidart, S of Biarritz, Pyrénées Atlantiques, SW France.

Stratigraphic range: Early Paleocene (P1) to Middle Eocene (P11) (fide van Morkhoven et al. 1986: 322).

In addition to the type locality and the Danian of Bidart, SW France, *Quadratobuliminella* has been recorded in widely dispersed areas (van Morkhoven et al. 1986, de Klasz et al. 1990). Boltovskoy (1989) mentioned it at DSDP site 305 from the Late Oligocene. However in a personal communication (18.6.1992) he wrote that he found this form in several DSDP boreholes (sites 167 - N Pacific; sites 363, 364 and 525A - South Atlantic) in levels varying from Paleocene to Middle Eocene. Boltovskoy & Watanabe (1982) figured very typical *Quadratobuliminella pyramidalis* from DSDP site 363; Boltovskoy & Boltovskoy (1989) found it in site 525A (late Paleocene - Middle Eocene). Widmark & Malmgren (1992) encountered *Quadratobuliminella* spp. in DSDP sites 465A (Central Pacific), 525A and 527 (South Atlantic) in both Maastrichtian and Danian deposits (with a pronounced increase in the Danian samples at site 465A). Specimens from the above three sites kindly sent to us by J. Widmark, Uppsala, are identical with topotypes of *Quadratobuliminella pyramidalis*, as are also forms which we obtained from D. Schnitker of Walpole, Me., USA, from the N. Atlantic site 401 (Gulf of Biscay). Widmark & Malmgren consider *Quadratobuliminella* as an infaunal genus.

Quadrimorphina trochoides (Reuss, 1846)
Pl. 2, Fig. 10 a, b

1846 *Globigerina trochoides* m. - Reuss: 36, pl. 12/22.

1962 *Allomorphina conica* Cushman & Todd. - von Hillebrandt: 90, pl. VI/21 a, b.

1988 *Quadrimorphina trochoides* (Reuss). - de Klasz et al.: 63, pl. 15/1 a-b.

? 1989 *Allomorphina conica* Cushman & Todd. - Boltovskoy & Boltovskoy: 299, pl. V/1-2.

Stensioeina beccariiformis (White, 1928)
Pl. 2, Fig. 13 a-c

1928 *Rotalia beccariiformis* n. sp. - White: 27, pl. 39/2 a-4 c.

1962 *Gavelinella beccariiformis* (White). - von Hillebrandt: 101, pl. VIII/2 a-c.

1978 *Gavelinella beccariiformis* (White). - Proto-Decima & Bolli: 793, pl. 6/3-4.

1986 *Stensioina beccariiformis* (White). - van Morkhoven et al.: 346-353, pl. 113 A-D.

1992 *Gavelinella beccariiformis* (White). - Widmark & Malmgren: pl. 5/3 a-c.

The taxonomic position and distribution of this species is discussed in detail by van Morkhoven et al. (1986). Our specimens are somewhat less thick than those figured by these authors or by Widmark & Malmgren (1992).

Stilostomella sp. A de Klasz,
de Klasz & Ausseil-Badie, 1988
Pl. 2, Fig. 6

1983 *Stilostomella* sp. - Tjalsma & Lohmann: 5, pl. 5/2.

1988 *Stilostomella* sp. A. - de Klasz, de Klasz & Ausseil-Badie: 59, pl. 12/17.

3. CONCLUSIONS

This paper completes recent studies (DE KLASZ et al. 1990, DE KLASZ & DE KLASZ 1990) on the only existing material from the no longer accessible type locality of the cosmopolitan mainly Early Paleogene deep water benthic foraminiferal genus *Quadratobuliminella* DE KLASZ, 1953.

The planktonic foraminifera used for age determination are illustrated in this paper, as are the principal calcareous benthic species (after the agglutinated forms were previously figured in DE KLASZ & DE KLASZ 1990). They indicate a Upper Danian age (lower part of BLOW's P2 zone).

The calcareous foraminiferal assemblage shows numerous common forms with various Early Paleogene faunas described from the Bad Reichenhall and the Salzburg Basin, the South Atlantic and the circum-Caribbean region, as does the agglutinated fauna of the Grub levels.

The finding of a sample residue of Bucheck Layers collected nearby south of the *Quadratobuliminella* type locality corroborates earlier observations, i. e. that the deposits represent a tectonic and not stratigraphic intercalation in the Bucheck Layers.

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